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PY-CEI/NRR-2251LUnited States Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555Perry Nuclear Power Plant
Docket No. 50-440
LER 97-016

Ladies and Gentlemen:

Enclosed is Licensee Event Report (LER) 97-016, "Vibration-Induced Turbine Electro-Hydraulic Control System Fluid Leak Results in Reactor Protection System and Engineered Safety Feature Actuations."

If you have questions or require additional information, please contact Mr. Henry L. Hegrat, Manager - Regulatory Affairs, at (440) 280-5606.

Very truly yours,



Enclosure: LER 97-016

cc: NRC Region III Administrator
NRC Resident Inspector
NRC Project Manager9801230393 980120
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NRC FORM 366 (4-95)		U.S. NUCLEAR REGULATORY COMMISSION		APPROVED BY OMB NO. 3150-0104 EXPIRES 04/30/98	
LICENSEE EVENT REPORT (LER)				ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS MANDATORY INFORMATION COLLECTION REQUEST: 50.0 HRS. REPORTED LESSONS LEARNED ARE INCORPORATED INTO THE LICENSING PROCESS AND FED BACK TO INDUSTRY. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE INFORMATION AND RECORDS MANAGEMENT BRANCH (T-6 F33), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555-0001, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.	
(See reverse for required number of digits/characters for each block)					
FACILITY NAME (1) Perry Nuclear Power Plant, Unit 1				DOCKET NUMBER (2) 05000440	PAGE (3) 1 OF 4
TITLE (4) Vibration-Induced Turbine Electro-Hydraulic Control System Fluid Leak Results in Reactor Protection System and Engineered Safety Feature Actuations.					
EVENT DATE (5)		LER NUMBER (6)		REPORT DATE (7)	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REVISION NUMBER
12	19	97	97	-- 016 --	00
				MONTH	DAY
				01	20
				YEAR	
				98	
OTHER FACILITIES INVOLVED (8)					
FACILITY NAME			DOCKET NUMBER		
			05000		
FACILITY NAME			DOCKET NUMBER		
			05000		
THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more) (11)					
OPERATING MODE (9)		20.2201(b)		20.2203(a)(2)(v)	
1				50.73(a)(2)(i)	
POWER LEVEL (10)		20.2203(a)(1)		50.73(a)(2)(ii)	
100		20.2203(a)(2)(i)		50.73(a)(2)(iii)	
		20.2203(a)(2)(ii)		50.73(a)(2)(iv)	
		20.2203(a)(2)(iii)		50.73(a)(2)(v)	
		20.2203(a)(2)(iv)		50.73(a)(2)(vii)	
				OTHER	
				Specify in Abstract below or in NRC Form 366A	
LICENSEE CONTACT FOR THIS LER (12)					
NAME				TELEPHONE NUMBER (Include Area Code)	
Todd A. Henderson, Supervisor-Compliance				(440) 280-5889	
COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)					
CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPROS	
SUPPLEMENTAL REPORT EXPECTED (14)					
YES (If yes, complete EXPECTED SUBMISSION DATE).				X NO	
				EXPECTED SUBMISSION	
				MONTH	
				DAY	
				YEAR	
ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines) (16)					
<p>On December 19, 1997, at 0939 hours, the Perry Nuclear Power Plant, Unit 1, automatically scrammed from 100 percent of rated thermal power, due to a Turbine Electro-Hydraulic Control (EHC) system tubing fluid leak which resulted in a turbine trip, Reactor Protection system (RPS) actuation, and subsequent Residual Heat Removal isolation logic actuation. Operators responded to the event in accordance with the appropriate procedures and the plant was safely shut down.</p> <p>The cause of this event is a vibration-induced fatigue failure of a section of turbine control valve (TCV) EHC system tubing. The vibration is the normal result of the pressure transients within the system during operation. Contributing causes to the tubing failure were the design application of the tubing fitting used to connect the EHC tubing to the TCV, and the support scheme of the tubing.</p> <p>The EHC tubing compression fittings for the applicable hydraulic lines at the four TCVs were replaced with welded flare fittings. Additional EHC tubing hangers were added to two of the four TCVs to provide additional tubing support closer to the fittings. A design modification to install an accumulator in the applicable TCV hydraulic lines to dampen the vibration is being evaluated. The applicable tubing and fittings at the TCVs are being monitored, as plant conditions permit, until an appropriate design modification is implemented.</p>					

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LICENSEE EVENT REPORT (LER)
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Perry Nuclear Power Plant, Unit 1	05000				2 OF 4
	440	97	-- 016	-- 00	

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

I. Introduction

On December 19, 1997, at 0939 hours, the Perry Nuclear Power Plant (PNPP), Unit 1, automatically scrammed due to a Turbine Electro-Hydraulic Control (EHC) system [TG] tubing [TBG] fluid leak which resulted in Turbine Control Valve (TCV) Fast Closure signals to the Reactor Protection system [JC] (RPS), an RPS actuation, and a subsequent Residual Heat Removal [BO] (RHR) isolation logic actuation.

Notification was made to the NRC via the Emergency Notification System at 1044 hours (ENF No. 33431), in accordance with the requirements of 10CFR50.72(b)(2)(ii). This event is being reported in accordance with 10CFR50.73 (a)(2)(iv) for an event that resulted in actuations of the RPS and RHR isolation logic.

At the time of the event, the plant was in Mode 1 at 100 percent of rated thermal power. The reactor pressure vessel (RPV) pressure was at approximately 1024 psig with reactor coolant at saturated conditions.

II. Event Description

On December 19, 1997, the PNPP Unit 1 was operating at 100 percent of rated thermal power. Prior to the event, no surveillance testing or plant evolutions were in progress. No maintenance was being performed on the turbine EHC system. At approximately 0939 hours, an annunciator, "EHC STANDBY PUMP START HEADER PRESS LOW" was received in the control room. The turbine tripped due to low EHC pressure and the reactor scrammed due to the TCV Fast Closure signals to the RPS. RPV dome pressure peaked at 1093 psig, and coolant level decreased below Level 3 to a minimum of 163 inches above the top of active fuel (TAF). The RPV dome pressure increase resulted in a Redundant Reactivity Control system actuation on high RPV pressure. RPV coolant level decreasing below Level 3 resulted in the generation of RPS Low Level actuation signals (the RPS actuation logic was already locked in) as well as RHR isolation signals. The valves associated with the RHR isolation signals were already closed prior to the event.

Operators responded to the event in accordance with the appropriate procedures. At 0942 hours, both EHC pumps were secured. RPV coolant level was restored and maintained within normal parameters by 1000 hours, and the RPS logic was reset at 1002 hours. RRCS logic was reset at 1003 hours, and the RHR isolation logic was reset at 1036 hours. Plant systems and components functioned as designed during the transient except for the Emergency Response Information system (ERIS) indication of RPS channel A status which did not indicate tripped until approximately 83 seconds after the other three RPS channels. The plant was maintained in Mode 3 (Hot Shutdown) until the equipment issues were resolved.

Investigation determined that the loss of EHC pressure was due to a TCV hydraulic fluid actuating supply (FAS) control line tubing failure. The tubing failure resulted in a loss of EHC fluid and the subsequent turbine trip. The failed tubing was replaced and it was determined that the EHC pumps were not damaged due to their operation after the fluid loss.

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Troubleshooting of the ERIS RPS channel A issue determined that a set of relay auxiliary contacts were subject to minor oxidation which caused the indication delay while the RPS channel A itself actuated as required. The contacts were cleaned and tested and the equipment returned to service.

The plant remained in Mode 3 until December 21, 1997, at 0408 hours, when the plant entered Mode 2 (Startup). Reactor startup commenced at 0638 hours.

III. Cause of Event

The cause of this event is vibration-induced tubing failure caused by internal hydraulic pressure pulsations associated with control valve/system operation. Pressure pulses are initiated by cyclic movement of the servovalves which position the TCVs. The cyclic movement is produced by small electrical signals superimposed on the controlling DC signal. When electrical signal frequency coincides with the resonant frequency of the FAS hydraulic lines, large pressure pulses can occur in the FAS lines. The vibration caused a fatigue failure of the tubing. This issue has been addressed by the vendor (General Electric Company) in Technical Information Letter (TIL) 1123-3, dated November 14, 1992.

Contributing causes to the tubing failure were the design application of the tubing fitting used to connect the FAS line to the control valve, and the support scheme of the tubing. Welded flare style EHC fittings for FAS and emergency trip supply (ETS) hydraulic lines at the turbine control valves were replaced with Swagelok compression fittings during the last refueling outage. This was done in an attempt to reduce leakage at these hydraulic connections. The compression fitting provides a gripping connection which makes the tubing material more susceptible to stress risers. The compression fitting generated a stress riser in the EHC tubing at the compression ferrule. The failed tubing fractured as a result of cyclic fatigue at the ferrule (stress riser area) of the compression fitting. The use of the compression fittings is a contributing factor to the tubing failure. Additionally, the failed FAS tubing was not supported fully in accordance with vendor criteria in the area of the failure. Appropriate tubing support in the affected area may have reduced the potential for the event to occur.

IV. Safety Analysis

This event is analyzed by the Updated Safety Analysis Report (USAR) Chapter 15.2.3, "Turbine Trip." A review of the USAR and the event data shows the plant performed within its design envelope. The USAR analysis provides anticipated peak plant parameters related to fuel and barrier performance. For the December 19, 1997, event, measured or calculated peak values for neutron flux, RPV bottom head pressure, and RPV dome pressure were less than the anticipated values in the USAR. No safety relief valves lifted so the radiological consequences of the event were less than analyzed. During the transient, RPV water level decreased to a low of approximately 163 inches above the top of active fuel. The event documented by this report was well within the bounding analyses of the USAR; therefore this event is considered to have minimal safety significance.

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TEXT CONTINUATION

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V. Similar Events

LERs 95-005, 95-008, 96-005, and 97-005 documented events in which RPS actuations resulted from Turbine Control Valve Fast Closure signals. In LERs 95-005 and 95-008, the signals were caused by Topaz inverter failures. In LERs 96-005 and 97-005, the signals were caused by Auxiliary Transformer trips/failures.

Corrective actions for the previous LERs could not reasonably be expected to prevent the event documented by LER 97-016.

VI. Corrective Actions

The following corrective actions have been taken or are in progress:

1. The EHC tubing compression fittings for the FAS and ETS hydraulic lines at the four TCVs were replaced with welded flare fittings (original design).
2. Additional EHC tubing hangers were added to two of the four TCVs to provide additional tubing support closer to the fittings.
3. The lessons learned from this event associated with more thorough consideration of parameters during development and implementation of design solutions were reviewed with the appropriate system and design engineers.
4. A design modification to install an accumulator for vibration dampening in each of the TCV FAS hydraulic lines is being evaluated for implementation by the end of the next refueling outage (RFO7).
5. The applicable FAS tubing and fittings at the TCVs are being monitored as plant conditions permit until an appropriate design modification is implemented.

The actions discussed in this document represent intended or planned actions, are described for the NRC's information, and are not considered to be regulatory commitments. Please notify the Manager - Regulatory Affairs at the Perry Nuclear Power Plant of any questions regarding this document or any associated regulatory commitments.

Energy Industry Identification System (EIIS) codes are identified in the text as [XX].

CATEGORY 1

REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

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SUBJECT: Forwards LER 97-016-00, "Vibration-Induced Turbine Electro-Hydraulic Control Sys Fluid Leak Results in Reactor Protection Sys & ESF Actuation."

DISTRIBUTION CODE: IE22T COPIES RECEIVED:LTR 1 ENCL 1 SIZE: 1+4
TITLE: 50.73/50.9 Licensee Event Report (LER), Incident Rpt, etc.

NOTES:Application for permit renewal filed.

05000440

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